Polymer/carbon nano pipe composite powder and its solid phase shear break up preparation method

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Abstract of **CN 1410475 (A)**
A polymer/carbon monometre tube composite powder is prepared from granular polymer (average grain size 10 microns-5mm), carbon nanometre tube (0.5-200 nm) and disperser through proportionally mixing in a high-speed stirrer for 5-20 min, and shear-dispersing in a solid-phase shear pulverizing for shear dispersing 1-50 times. It can be used to prepare the plastic, rubber and fibre product with electrically conducting, antistatic, thermally conducting, electromagnetic shielding and microwave absorbing performances.

Claims:

1. A polymer/carbon nanotube composite powder produced from a starting material comprising 5 to 300 parts of polymer, 0.1 to 600 parts of carbon nanotubes, 0 to 10 parts of a dispersant (all parts by weight), wherein the polymer has an average particle diameter of 100nm to 5mm, and is selected from the group consisting of polyethylene, polypropylene, polycarbonate, polymethyl methacrylate, polybutylene terephthalate, polyethylene terephthalate, polyetheretherketone, polyurethane, polyamide, polystyrene, polyvinylchloride, polyformaldehyde, chloroprene rubber, acrylonitrile butadiene rubber, butadiene styrene rubber and/or poly (acrylonitrile butadiene styrene) copolymer, and wherein the carbon nanotubes have an average diameter of 0.5 to 200nm and a length of 200nm to 20μm, and are at least one member of single-walled carbon nanotubes and/or multi-walled carbon nanotubes, and wherein the dispersant is at least one member selected from the group consisting of higher fatty acids, silane coupling agents, titanic acid coupling agents, Span, Tween, OP, hexadecyl trimethyl ammonium bromide, polyacrylic acid salts and/or polymethacrylic acid salts.

2. A process for producing a solid-state shear dispersion of a polymer/carbon nanotube composite powder according to claim 1, the process comprising the steps of:

a) supplying 5 to 300 parts of polyethylene, polypropylene, polycarbonate, polymethyl methacrylate, polybutylene terephthalate, polyethylene terephthalate, polyetheretherketone, polyurethane, polyamide, polystyrene, polyvinylchloride, polyformaldehyde, chloroprene rubber, acrylonitrile butadiene rubber, butadiene styrene rubber and/or poly (acrylonitrile butadiene styrene) copolymer, which has (have) an average particle diameter of 100nm to 5mm; 0.1

to 600 parts of single-walled carbon nanotubes and/or multi-walled carbon nanotubes which have an average diameter of 0.5 to 200nm and a length of 200nm to 20μm; 0 to 10 parts of a dispersant selected from the group consisting of higher fatty acids, silane coupling agents, titanic acid coupling agents, Span, Tween, OP, hexadecyl trimethyl ammonium bromide, polyacrylic acid salts and/or polymethacrylic acid salts, to a high-speed mixer and mixing components for 5 to 20 minutes at 50 to 500 rpm; and

b) supplying an uniform mixture of said polymer, carbon nanotubes and/or a dispersant to a solid-state shear pulverization device, pouring 5°C to 40°C circulating water into a cavity in an outer surface of a static abrasive disc, bringing the solid-state shear pulverization device into operation with a rotation speed from 10 to 1,000 revolutions per minute, and performing 1 to 50 times of shearing, pulverization, dispersion and mixing to obtain the polyethylene/carbon nanotube composite powder.

3. Use of the polymer/carbon nanotube composite powder according to claim 1 or 2, comprising subjecting the composite powder to extrusion molding, injection molding or hot-roll molding, or mixing the composite powder with another resin mixture to obtain a composition, and subjecting the composition to extrusion molding, injection molding or hot-roll molding, so as to obtain a plastic, rubber, and a textile product having electrical conducting, anti-electrostatic, thermally conducting, electromagnetic shielding and microwave absorbing properties; or comprising adhering the polymer/carbon nanotube composite powder to a substrate by way of electrostatic coating, molten plating bath immersion, fluidized bed, etc. to form a polymer/carbon nanotube composite material coating.

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Examples:

1. 300g of polyethylene having an average particle diameter of up to 100 μm, and 6g of carbon nanotubes having an average diameter of 20 to 40nm and a length of about 1 to 10 μm, are supplied to a high-speed mixer and evenly mixed. The mixing is carried out for 20 minutes at 400rpm. Every 5 minutes, the stirring is stopped for 3 minutes to prevent softening and adhering of the polymers due to the frictional heat.

Circulating water is poured into a cavity in the outer surface of a static abrasive disc of an abrasive disc-type mechano-chemical reactor (Chinese Patent ZL95111258.9). The water temperature is 15 to 20°C. The abrasive disc-type mechanochemical reactor is brought into operation, and the rotation speed is set to 40 to 50 revolutions per minute.

A mixture comprising polyethylene powder and carbon nanotubes is supplied through an inlet, and polishing pulverization is performed. The supply rate and rotation speed of the abrasive disc are controlled so that the retention time of the material in the abrasive disc is 20 to 40 seconds.

The pulverized mixture is again polished with the abrasive disc, and the resulting fine powder is collected. The powder is polished 30 times to give a polyethylene/carbon nanotube composite-powder having uniform color appearance.

Evaluation of the powder revealed that, compared with a simple polyethylene, the tensile strength improved up to 20%, the impact strength improved 15 to 30%, and the electroconductivity is $10^{-6}S.cm^{-1}$.